Takasi Yamazaki*: **Notes on Lindernia, Vandellia, Torenia and their allied genera in Eastern Asia 1**

山　崎　　敬: 東亜産アゼナ属, ウリクサ属とその類縁 1

A. Earlier systems. *Lindernia* and allied genera very much resemble each other, so that to draw a sharp line between them is not am easy task. They have been distinguished into *Lindernia*, *Vandellia*, *Ilysanthes*, *Bonnaya*, *Hornemannia*, *Tittomania*, *Ilyogeton*, *Bazina* and *Craterostigma* by the characters of their calyces, stamens and fruits etc. To these taxons, *Geoffraya*, *Bonnayodes* and *Chamaegigas* havh been added recently, and there are many opinions as to the classification of these groups. Hance (in Ann. Soc. Nat. Sér IV-**15**: 226, 1861) maintained that *Vandellia* should be combined with *Torenia*. F. v. Müller (Syst. Census. Austr. Pl. **1**, 1882, not seen, from T. Makino) also maintained that *Vandellia*, *Bonnaya*, *Ilysanthes*, *Tittomania*, *Ilyogeton* and a part of *Torenia* should be combined with *Lindernia*. Urban (1884) recognized only two genera, namely *Lindernia* with 4 fertile stamens and *Ilysanthes* with 2 fertile stamens and 2 staminodes. *Vandellia*, *Hornemannia*, *Tittomania* and *Ilyogeton* are to belong to the former, while *Bonnaya* and *Bazina* to the latter. This Urban's view has been succeeded by the later taxonomists such as Wettstein (1895) and Merrill (1923), although Engler (in Engler Bot. Jahrb. **23**: 500, (1897) insisted that such a treatment is too much mechanical. Haines (Botany of Bihar and Orissa: 630, 1922, not seen, from S. K. Mukerjee) has also reduced into two genera based upon the other standpoint, namely *Bonnaya* and *Hornemannia* are to be united with *Vandellia*, while *Ilysanthes* is to be combined with *Lindernia* by the resemblance of the nervation of leaves as suggested by J. B. Hooker (Fl. Brit. Ind. **4**: 283, 1884).

Lindernia, *Vandellia*, *Hornemannia* and *Tittomania* have two large anterior filaments having fertile anthers and small appendices at their bases, while in *Ilysanthes* and *Bazina*, two anterior stamens completly lacking anthers, reduced filaments and large appendices. In some *Ilysanthes* species, i. e. *I. refrecta*, two antherior stamens consist of large appendices and small degenerated filaments (Fig. 1 and 2), so the appendices look like the filaments. In *Bonnaya*, the anterior stamen is only formed of a filiform process. This

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process was interpreted by Pennell (1935) as a appendix which was formed by the sharp inbending of the filament as to be seen in *Lindernia* and *Ilysanthes* and shows not other than a transitional stage from the latter. For this reason, Pennell maintained that *Lindernia* connects with *Bonnaya* through *Ilysanthes* having intermediate stamens and they should be united to a genus. This view has been succeeded by the subsequent authors as H. Hara (1943), S. K. Mukerjee (1945) and H. L. Li (1950).

B. Observation. 1) **Development of the anterior stamens.** From the above mentioned facts, we can recognize three types of the anterior stamen in these groups. In *Lindernia* and *Vandellia* which have stamens of the first type, the anterior stamen is only formed of filament and shows no sign of appendices at an early age (Fig. 1. 1), but subsequently, the tubercular process appears at the base (Fig. 1. 2). This process gradually increases in its size and becomes thicker than the filament, thus the large filiform appendix is formed (Fig. 1. 3, 4). In the cleistogamous flowers of *Lindernia pyxidaria*

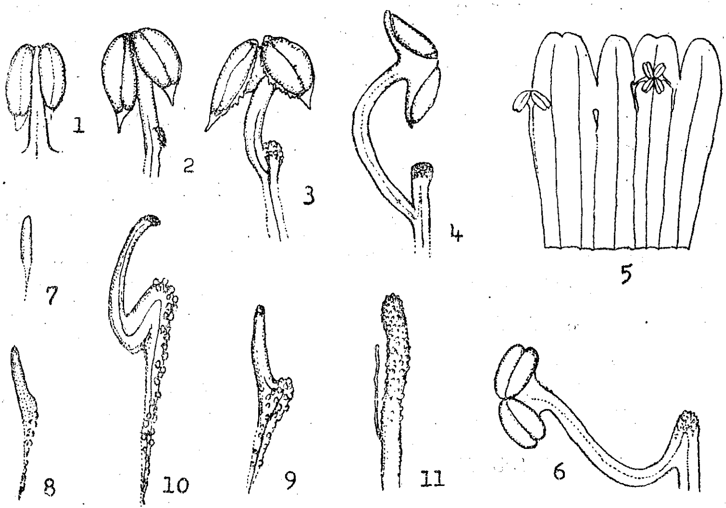


Fig. 1. 1-4) Development of the anterior stamen of *Vandellia angustifolia* (=*Tittomannia angustifolia*). 5) Corolla expanded of the cleistogamous flower of *Lindernia pyxidaria.* ×15. 6) Anterior stamen from 5, magnified to sharp inbended filament. 7-10) Development of the anterior stamen of *Lindernia dubia* (=*Ilysanthes dubia*). 11) Anterior stamen of *Lindernia refracia* (=*Ilysanthes refracta*).

(Fig. 1. 5), it is certain that anterior filaments have small tubercular processes which are formed by the sharp inbending at the middle of filaments (Fig. 1. 6), and it is proved by the running course of the inbended vascular bundles that the appendices of the normal flowers are formed by the same manner as in those of the cleistogamous ones. In *Ilysanthes* having the second type, the appendices are formed in the same manner as in those of *Lindernia*, but the anterior anthers are lacking from the beginning (Fig. 1. 7-10). In *Bonnaya* having the third type, each of anterior stamens at an early stage, is formed of a short spatulate process with a lateral minute projection in its base (Fig. 2. 1, 2), subsequently, this spatulate process rapidly grows in length and its tip is covered with a transparent cap-shaped body which is considered to be the degenerated anther (Fig. 2. 3, 4), while the minute projection does not increase in size and gradually disappears (Fig. 2. 5, 6). From the above mentioned facts, it is interpreted that the anterior process of *Bonnaya* is not derived from the appendix as to be seen in *Ilysanthes*, but is the filament itself. In spite of the opinion of Pennell (1935) on the development of the anterior stamens, that the stamen of *Ilysanthes* connects with that of *Bonnaya*, I think that the stamen of *Ilysanthes* connects with that of *Lindernia*, and in *Bonnaya* it takes a independent developmental course, that is, the former is tending to loss the filament, while the latter to loss the appendix. Perhaps the second and the third type may have been derived from the first.

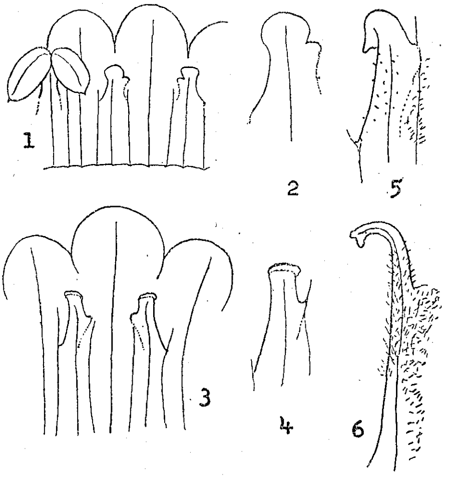


Fig. 2. 1-5) Development of the anterior stamen of *Vandellia anagallis* (=*Bonnaya verbenaefolia*). 2) Anterior stamen from 1, magnified to show a transparent cap-shaped body.

2) **Anthers.** There are some variations in the anthers. In *Lindernia* and *Ilysanthes*, the connectives grow scarcely, so the end of the anthers become emarginate (Fig. 1. 6). In *Vandellia*, *Hornemannia* and *Bonnaya*, as the con-

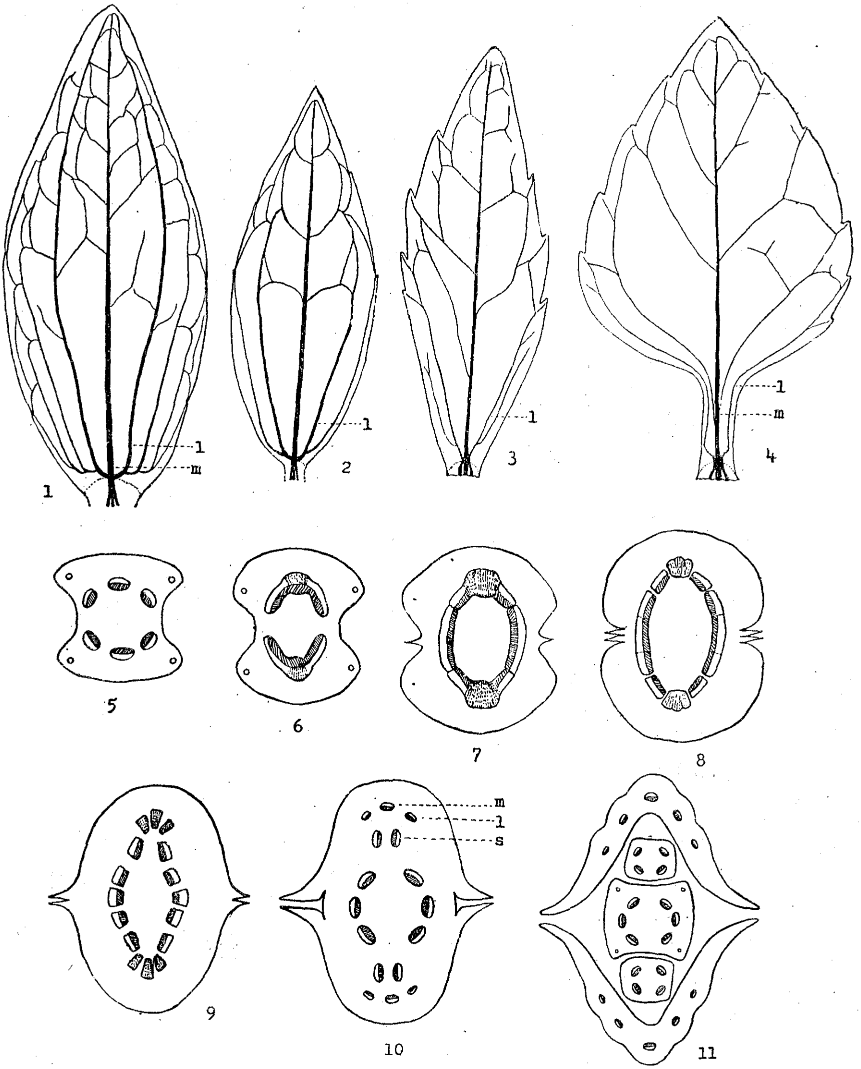


Fig. 3 1-4) Leaf venation; 1) *Lindernia pyxidaria.* 2) *Lindernia dubia* (=*Ilysanthes dubia* 3) *Vandellia anagallis* (=*Bonnaya verbenaefolia*). 4) *Vandellia crustacea* (=*Hornemannia ovata*). 5-11) *Lindernia pyxidaria.* Cross section of the node at successive levels from base upward. m, midrib leaf bundle; l, lateral leaf bundle; s, lateral shoot bundle.

nectives grow, the end of the anthers become acute, especially, in *Vandellia angustifoiia* and *Vandellia cordifolia*, the connectives make so remarkable growth as to end with the spur (Fig. 1. 3).

3) **Leaf venation.** In *Lindernia* and *Ilysanthes*, the foliage leaves have the entire margine or the obscure teeth with no vascular strand and the palmate nerves being separated in three remarkable veins (Fig. 3. 1, 2), while, in *Bonnaya*, *Vandellia* and *Torenia*, it has the teeth with a vascular strand and the pinnate nerves (Fig. 3. 3, 4).

In these genera, the stem has six bundles which consist of two groups each containing three bundles (Fig, 3. 5). These bundles unite at the base of the node to form an unbroken cylinder (Fig. 3. 6, 7). The leaf traces are then given off at two opposite sides, and immediately separate into three bundles containing a median and two lateral ones. A pair of the branch traces is then given off (Fig. 3. 8, 9). Each of two remaining stem bundles separates into three bundles, thus the stem has again six bundles being arranged perpendicularly to the previous plane of the stem bundles (Fig. 3. 10,11).

In *Lindernia* and *Ilysanthes*, the growth of two lateral leaf bundles are remarkable, so the palmately nerved leaf is formed. While, in pinnately nerved leaf, two lateral leaf bundles are reduced early, and a median bundle sends off many lateral veins in its course throughout the lamina.

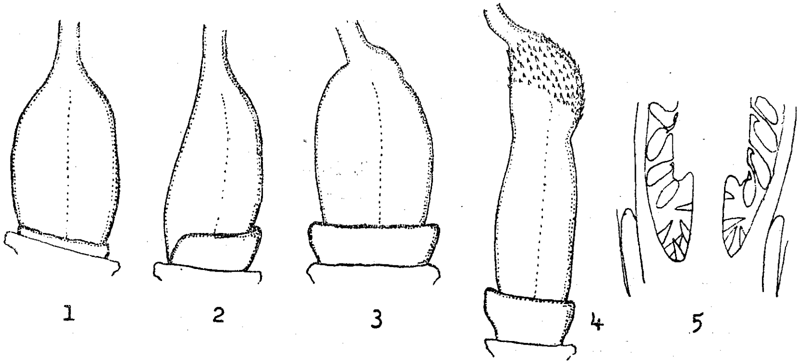


Fig. 4. Ovaries. 1) *Lindernia pyxidaria.* 2) *Vandellia angustifolia* (=*Tittomannia angustifolia*). 3) *Vandellia crustacea* (=*Hornemannia ovata*). 4) *Torenia violacea.* 5) Longitudinal section of the ovary of *Torenia violacea.*

4) **Ovaries.** In *Lindernia pyxidaria*, the ovary is somewhat radially sym-

metrical, glabrous throughout and surrounded with a small disk in its base (Fig. 4. 1). In *Ilysanthes dubia,* it is oblong, bilateraly symmetrical, glabrous throughout and surrounded with the small disk. In *Bonnaya verbenaefolia* and *Vandellia angustifolia,* it is oblong, bilateraly symmetrical and glabrous throughout, the apex of the ovary gradually transits to the style and the base is surrounded with the remarkable disk having a cleft in dorsal side (Fig. 4. 2). In *Vandellia crustacea,* it is ovoid, bilateraly symmetrical and glabrous throughout, the apex of the ovary has a little swellieg in ventral side and abruptly transits to the style, the base is surrounded with the remarkable entire disk (Fig. 4. 3). In *Torenia,* the terete ovary is bilaterally symmetrical, the apex of the ovary minutely pubescent, remarkably swollen and has a constricted ring at the upper middle portion, the base is surrounded with the remarkable entire disk (Fig. 4. 4). There is a minute pubescence growing on the inner basal side of the ovary wall which cannot be found at all in the other related genera (Fig. 4. 5).

5) **Seed surface.** In *Bonnaya,* Vandellia and *Torenia,* the seeds **bear** some hollows and many projections on the surface of the seed-coat (Fig. 5. 2). In *Lindernia* and *Ilysanthes,* the seeds bear no hollow nor projection, so the seed-coat usually appears smooth (Fig. 5.1).

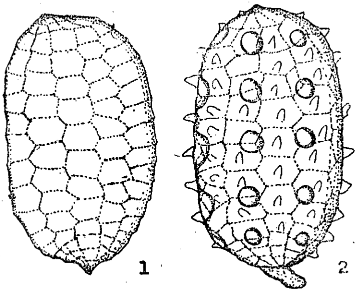


Fig. 5. Seeds. 1) *Lindernia dubia* (=*Ilysanthes dubia*). 2) *Vandellia crustacea* (=*Hornemannia ovata*). ×9.

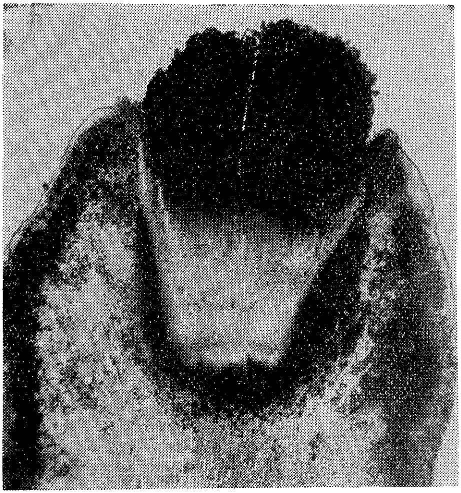
Pennell (1935) reported that *Ilysanthes riparia* and *I. anagallidea* resemble very close to *Lindernia pyxidaria* in habits, leaves, pedicels, sepals, corollas, capsules and seeds, and the stamens are alike even in the peculiar anterior filaments but in *Ilysanthes* the filaments lack anthers. In view of such close similarity it becomes impossible to maintain a suggestion that *Ilysanthes* as a genus or even as a section of *Lindernia.* I agree with Pennell's opinion that *Ilysanthes* should be combined with *Lindernia,* but in spite of his opinion that it formes a large clearly natural genus to unite the four-anthered *Lindernia* and *Vandellia* with the two anthered *Ilysanthes* and *Bonnaya,* I think it is more provable that they may be divided into two large groups as Haines's opinion (1922); namely *Lindernia, Ilysanthes* and

Ilyogeton belong to the one group, *Vandellia*, *Tittomania*, *Hornemannia* and *Bonnaya* to the other. It is also recognizable from the processes of the endosperm formation (unpublished, the details will appear in my another article).

アゼナ・ウリクサ類は形態的な変化が著しく，古くから属の分類には種々の見解がある。主な群をあげると*Lindernia*（アゼナ属），*Ilysanthes*（アメリカアゼナ属），*Bonnaya*（スズメノトウガラシ属），*Vandellia*（アゼトウガラシ属），*Tittomannia*（シソバウリクサ属），*Hornemannia*（ウリクサ属），*Torenia*（ハナウリクサ属）など，各群はそれぞれ一度は属として扱つた人がある位である。現在は Pennell 氏 (1935) の意見にしたがつて，ハナウリクサ属以外はすべて１つの属にまとめて *Lindernia* として扱う人が多い。ここでは各群に現われた形質がどのようにして作られ，それぞれどのような関連があるかを検討した。最も目につきやすく，古くから問題にされているのはおしべの形である。アゼナ類，アゼトウガラシ類，シソバウリクサ類では，下側の２雄蕊は花糸の基部が著しく彎曲して棒状に突出している。この突起は昆虫が蜜を吸うとき自然その上に足を置かねばならないような位置にあり，恐らく突起が下にさげられるとそれと連絡している花粉袋がさがつて，昆虫の背に花粉をつけるような仕組になつていると考えられる。然しこの類は自家受粉のものが多く，虫媒の目的で発達したと考えられる下側雄蕊も，その花粉袋は小さくなり退化の傾向を示している。アメリカアゼナ類では下側雄蕊の花糸の形は前記と同じで，種類によつては棒状部の発達はいつそう著しいが花粉袋は全く消失している。スズメノトウガラシ類は下側雄蕊は１本の棒のみからなる，Pennell 氏はこれを附属突起とみなし，アメリカアゼナ類よりもいつそう変化が進んで花糸が全く消失したものと考え，したがつてこれらが一連のものとみなした。然しスズメノトウガラシ類の雄蕊の出来方をみると，この棒は附属突起でなく花糸そのものであることが明らかで，附属突起は全く発達していない。アメリカアゼナ類・スズメノトウガラシ類の雄蕊はいずれもアゼナ類にみられるような形のものから変化したものであろうが，一連のものでなくそれぞれ別の方向へ変化したものと思われる。これらの群でいま一つ著しい性質は葉脈の走りかたである。アゼナ・アメリカアゼナ類では 2～4 本の顕著な側脈が主脈とほぼ平行に走り掌状脈をなし，全縁か不明瞭な鋸歯をもつ。他の類はすべて主脈のみが著しく網状脈をもち，明瞭な鋸歯をもつ。この違いは葉が茎から分れる際現われる２本の側脈が，前者ではよく発達して分枝し葉身のかなりの部分を占めているが，後者では２本の側脈は小さく葉身の下部で消失し，葉身の殆んどは主脈から分枝した脈で占められていることによる。アゼナ・アメリカアゼナ類では種子は孔をもたず，又表面はなめらかであるが，他のものは種子形成の際胚乳をとりまく珠皮の一部の細胞が巨大となり，胚乳の中に入りこんで孔を作る。又表皮細胞の側膜は厚くなり種子の成熟後突起として残る。このようにアゼナ・アメリカアゼナ類と他の類との間には大きな

違いがありすべてを一つの属として扱ふのは妥当でない，このことは後報する胚乳形成の機構にも認められる。

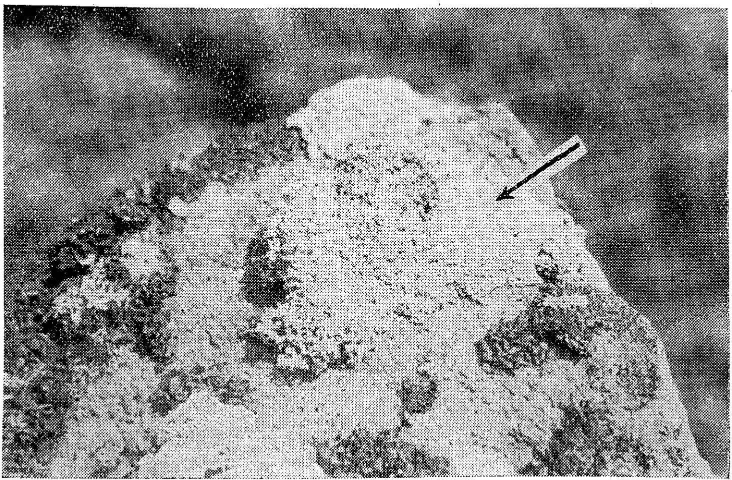
○本土に於けるカニメゴケ第二の産地 (朝比奈泰彦) Yasuhiko ASAHINA: Second locality of *Acroscyphus sphaerophoroides* Lév. in Hondo, Japan.



Vertical section of Apothecium of *Acroscyphus sphaerophoroides*. (Photo. Y. Asahina).

For the second time *A. sphaerophoroides* Lév. was collected on Mt. Ontake (Hida side), ca 2750m.

1952年に黒川逍君1)が信州三ツ岳でカニメゴケ発見の先鞭を附けてから本種の本土産出は確定し第二の産地の報告が期待されて居たが本年(1954)夏筆者は富樫誠，黒川逍両君と共に木曾教育会主催の御嶽調査団に参加し飛彈口から登山した際飛彈頂上から約100米下のハイマツ群落上に突出する岩塊上（標高約2750米）で良好なカニメゴケの標本を採集した。今回の獲物2個の内一つは大さ8×7cm，他の一つは5×6cm何れも筆者の乾園中に納めた。



Natural habit of *A. sphaerophoroides* Lév. on Mt. Ontake, Hondo. (Phot. M. Togashi).

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1) J. J. B., 28: 96